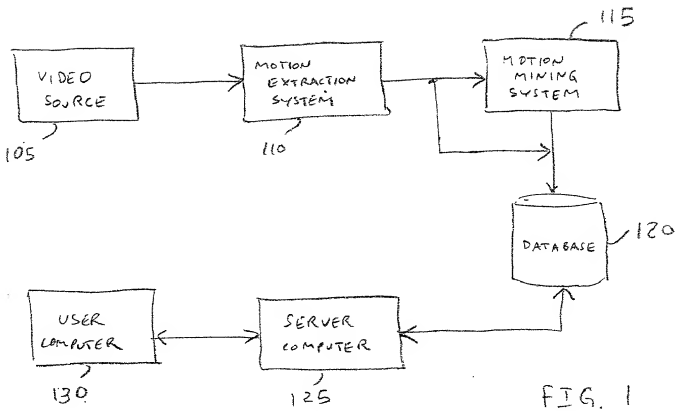

115
VIDEO SOURCE
105
MOTION EXTRACTION SYSTEM
110
MOTION MINING SYSTEM
DATABASE
120
USER COMPUTER
130
SERVER COMPUTER
125

FIG. 1

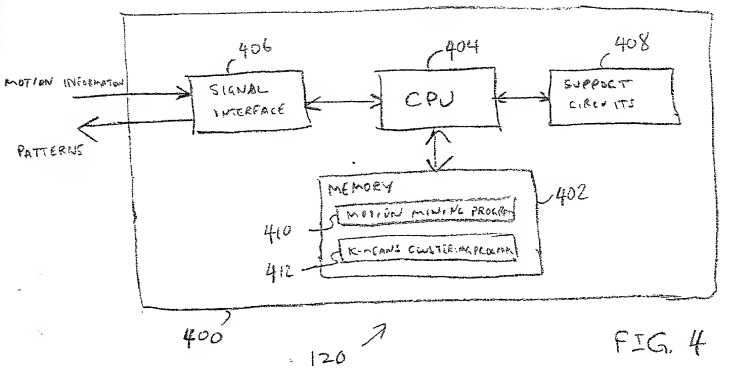

406
404
408
MOTION INFORMATION
SIGNAL INTERFACE
CPU
SUPPORT CIRCUITS
PATTERNS
MEMORY
402
410
412
400
120

FIG. 4

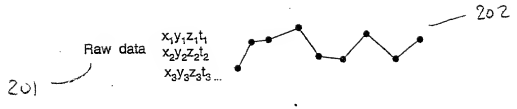
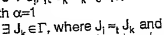


FIG. 2A

MOTION (TRAJECTORY) INFORMATION	Symbol	OPERATION ON RAW DATA	Explanations
Time span	T	range	
Region	R	area, $\cap$	
Begin point	B	$\subset$	contained in
End point	E	$\subset$	contained in
Speed range	S	$\cap, \subset, \supset$	
Direction	V	$=_\theta$	
Accel range	A	$\cap, \subset, \supset$	
Shape	H	$\approx$	
Path	P	$\sum_i, =_i, =_o$	union, time shifted, overlap

206

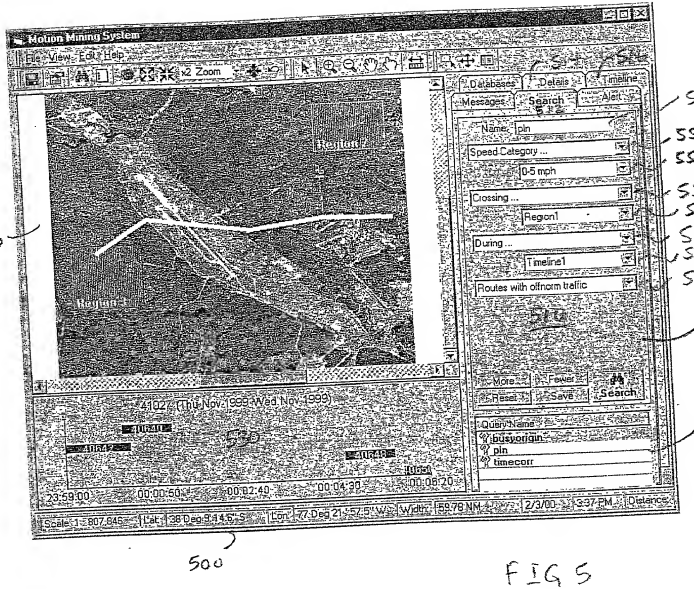
FIG. 2B

Motion patterns examples	Query based on operators (α, β are user input/parameters)
• Object stopping	$\{J: J.A \cap [-\infty, 0)$ and $0 \in J.S\}$
• Object moving fast	$\{J: J.S \subseteq [\alpha, \infty)\}$
• Active region	$R = \cap_i J_i.R$, where $\|\{ J_i \}\| > \alpha$ and $R.area < \beta$
• Source region	$R = \cap_i J_i.B$, where $\|\{ J_i \}\| > \alpha$ and $R.area < \beta$
• Beaten path	$P = \sum_i J_i.P$, where $\forall J_i$ $\|\{ J_k : J_k =_o J_i \}\| > \alpha$
• Road	beaten path with α=1
• Convoy	$\Gamma = \{J_j\}$: $\forall J_i \in \Gamma \; \exists J_k \in \Gamma$, where $J_i =_t J_k$ and $\|\Gamma\| \geq \alpha$
• Ran a traffic light	deviation from traffic direction  time
• Illegal parking	object stopped while object in front moves

310

300

FIG. 3



520

562

554

554C

556

556C

558

558C

560

550

552

538

500

FIG 5

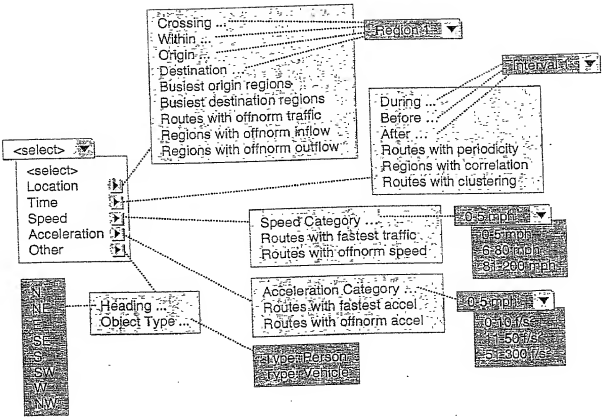

Crossing ...
Within ...
Origin ...
Destination ...
Busiest origin regions
Busiest destination regions
Routes with offnorm traffic
Regions with offnorm inflow
Regions with offnorm outflow
Region1
Interval1
During ...
Before ...
After ...
Routes with periodicity
Regions with correlation
Routes with clustering
<select>
<select>
Location
Time
Speed
Acceleration
Other
Speed Category ...
Routes with fastest traffic
Routes with offnorm speed
0-5 mph
0-5 mph
5-30 mph
30-60 mph
60-200 mph
N
NE
E
SE
S
SW
W
NW
Heading ...
Object Type ...
Acceleration Category ...
Routes with fastest accel
Routes with offnorm accel
0-5 mph
0-5 mph
0-10 ft/s²
10-50 ft/s²
50-300 ft/s²
Type=Person
Type=Vehicle

FIG. 6

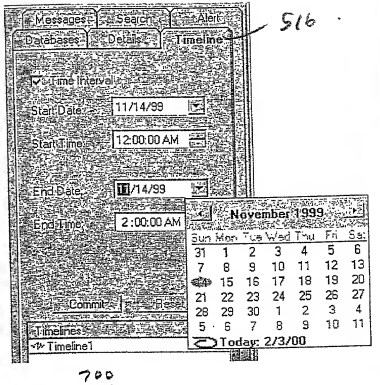

Messages
Search
Alert
Databases
Details
Timeline
516
Time Interval
Start Date:
11/14/99
Start Time:
12:00:00 AM
End Date:
11/14/99
End Time:
2:00:00 AM
November 1999
Sun Mon Tue Wed Thu Fri Sat
31 1 2 3 4 5 6
7 8 9 10 11 12 13
14 15 16 17 18 19 20
21 22 23 24 25 26 27
28 29 30 1 2 3 4
5 6 7 8 9 10 11
Today: 2/3/00
Commit
Timelines
Timeline1
700

FIG. 7

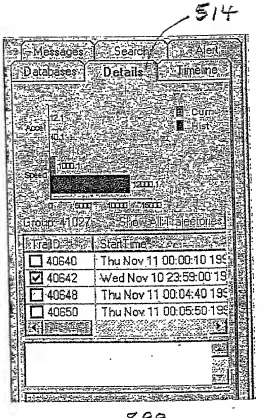

514
Messages
Search
Alert
Databases
Details
Timeline
Cum
Int
Speed
Group: 1027
Show Unassociated
Trial ID
Start Time
40640
Thu Nov 11 00:00:10 19
40642
Wed Nov 10 23:59:00 19
40648
Thu Nov 11 00:04:40 19
40650
Thu Nov 11 00:05:50 19
800

FIG 8

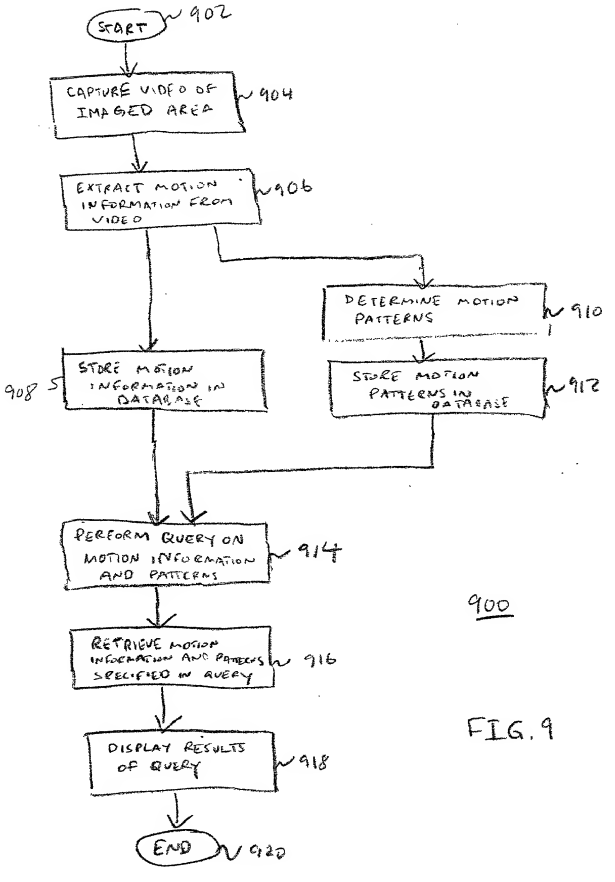

START
902
CAPTURE VIDEO OF IMAGED AREA
904
EXTRACT MOTION INFORMATION FROM VIDEO
906
DETERMINE MOTION PATTERNS
910
STORE MOTION INFORMATION IN DATABASE
908
STORE MOTION PATTERNS IN DATABASE
912
PERFORM QUERY ON MOTION INFORMATION AND PATTERNS
914
900
RETRIEVE MOTION INFORMATION AND PATTERNS SPECIFIED IN QUERY
916
DISPLAY RESULTS OF QUERY
918
END
920

FIG. 9

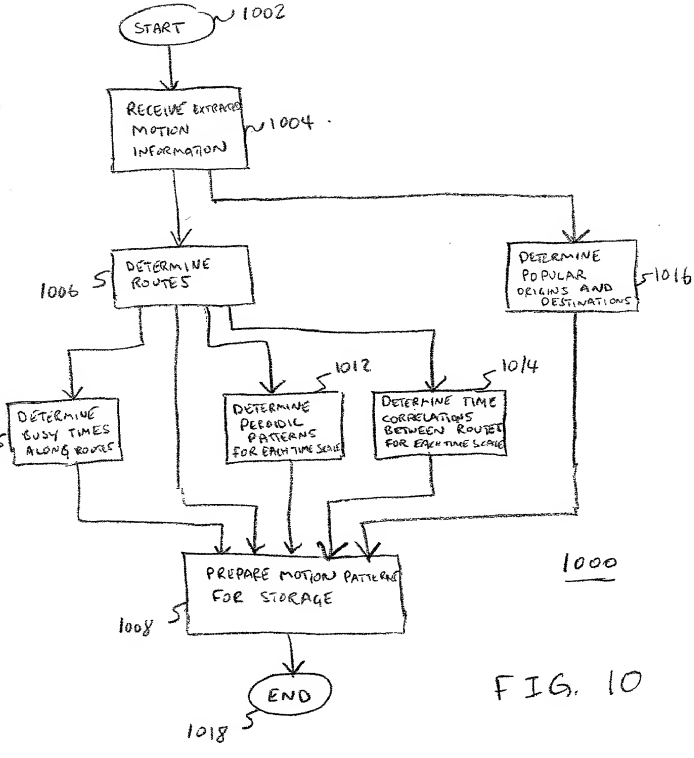

START
1002
RECEIVE EXTRACTED MOTION INFORMATION
1004
DETERMINE ROUTES
1006
DETERMINE POPULAR ORIGINS AND DESTINATIONS
1016
DETERMINE BUSY TIMES ALONG ROUTES
1010
DETERMINE PERIODIC PATTERNS FOR EACH TIME SCALE
1012
DETERMINE TIME CORRELATIONS BETWEEN ROUTES FOR EACH TIME SCALE
1014
PREPARE MOTION PATTERNS FOR STORAGE
1008
END
1018
1000

FIG. 10